

BALLAST WATER TREATMENT ABOARD THE

REGAL PRINCESS & SEA PRINCESS

**MTS RESEARCH & TECHNOLOGY
CONFERENCE**

15 NOVEMBER 2001

PRINCESS CRUISES

“Regal Princess”



PRINCESS CRUISES

"Sea Princess"

System Installed September 2001



Princess Cruises Initiative

- First in the cruise industry to pilot a Ballast Water Treatment System
- First system operational in March 2000
- Second generation system installed in September 2001
- Functioning continuously for both ballasting and deballasting operations

Princess Cruises

Ballast Water Treatment Program



- Minimal reduction in ballast system pressure
- Minimal operational problems
- Low maintenance (replacing UV lamps)

Installation Aboard the "Regal Princess"

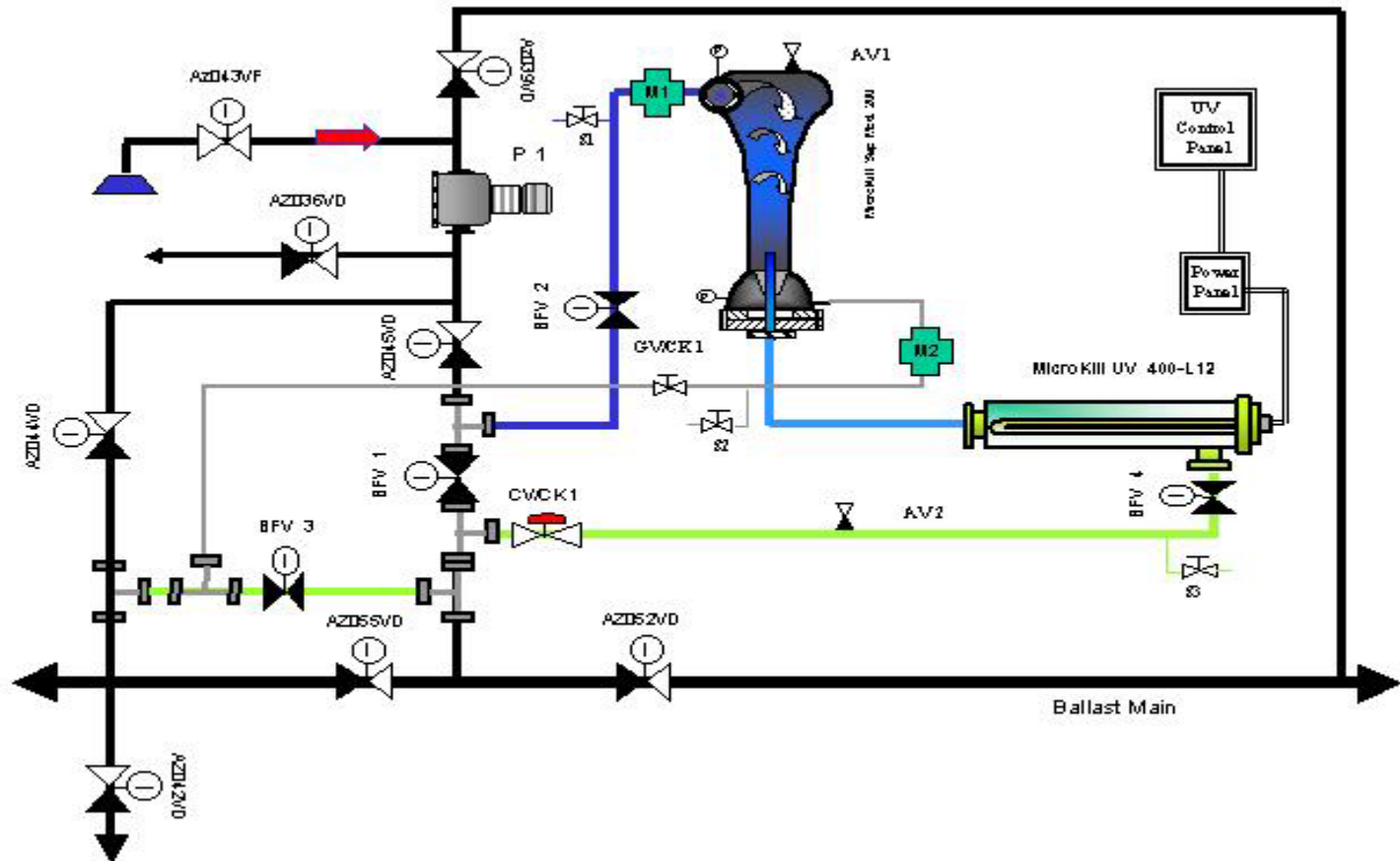


Full Scale Cyclonic/UV System Aboard "Regal Princess"



OptiMar Ballast System Onboard "Regal Princess"

Flow Diagram C/S Regal Princess



“Regal Princess”

- **Separator on Right**
- **UV on Left**



"Sea Princess"



- UV on left (horizontal)
- Separator on right (vertical)

Installation Aboard the "Sea Princess"



Second Generation System MicroKill Separator



- A completely updated design.
- The internal geometry has been modified
 1. improve particulate removal efficiency
 2. reduce the water flow in the sludge discharge
 3. maintain low pressure loss

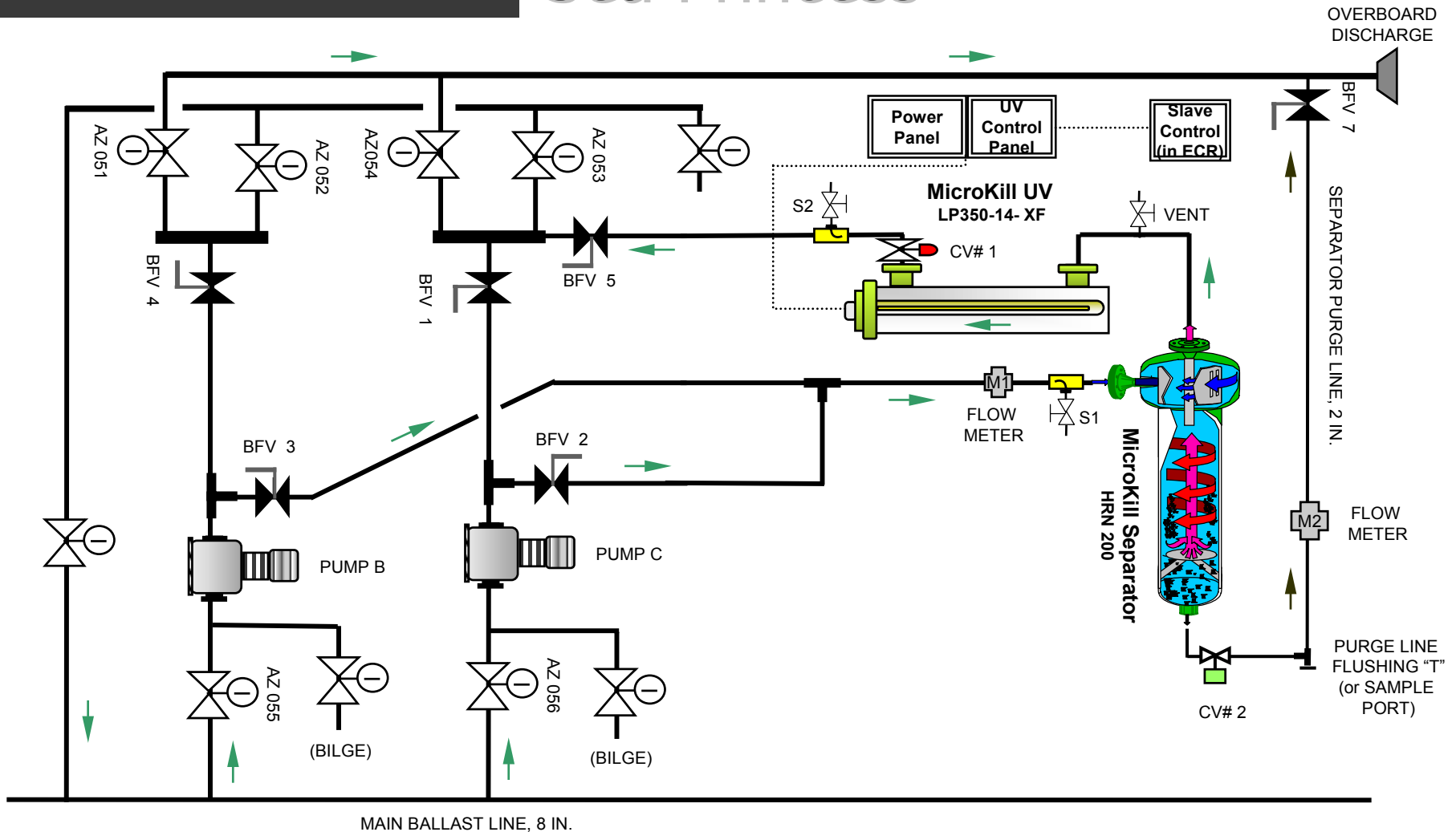
Second Generation System

MicroKill UV



- Supplied with 14 Low Pressure UV lamps (compared to 12 on the Regal)
- The spacing between tubes was changed to make the flow pattern more effective in the UV chamber, increasing the UV intensity.
- The result is that the actual UV-C dosage delivered to the ballast water is more than 50% higher than in the previous system.

OptiMar Ballast System Onboard "Sea Princess"



Full Scale 2nd Generation Cyclonic/UV System Aboard "Sea Princess"



Conclusions And Recommendations

- Treatment at the source, during ballasting, appears to be the most practical alternative
- Mechanical Separation followed by UV Irradiation, appears to be an effective and feasible treatment method
- Continued testing is to be performed, both for pilot plant and full-scale shipboard tests
- Simplicity and reliability are essential for onboard treatment systems